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Tracked Vehicle Road Wheel Puller

by Jean W. Pharaon

ARL-TN-343 **February 2009**

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14. ABSTRACT
A wheel-puller assembly is for forcibly removing a road wheel from a hub and axle associated with a tracked vehicle. The road wheel further includes outer and inner wheel components bolted to a circular array of lugs extending from the vehicle hub. The assembly includes a substantially flattened and plate-shaped base and a leg extending upwardly from the base, which is typically pivotally connected thereto. A powered cylinder secures to an upper end location of the leg and includes first and second telescoping components terminating in a clamp exhibiting a plurality of radially outwardly extending claws. The claws terminate in inwardly directed fingers for engaging respective locations along an annular rim associated with at least one of the outer and inner road wheel components. The clamp is adapted to engaging a location associated with the road wheel and in order to apply at least one of a pulling and twisting force to forcibly remove the road wheel from the hub.

15. SUBJECT TERMS
wheel puller, tracked vehicle, axle, hub, road wheel

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1. Government Interest

The invention described herein may be manufactured, used, and licensed by or for the U.S. Government.

2. Field of the Invention

The present invention relates generally to devices for removing a road wheel from a tracked vehicle. In particular, the present invention discloses a ground-supported, powered, and articulated device exhibiting a clamp fixedly secured to a location of the road wheel and for forcibly removing the wheel from its axle by applying a combined pulling and twisting force.

3. Background of the Invention

Tracked vehicles such as tanks and armored personnel carriers are the known vehicles the present art is intended for. These include the provision of a plurality of axle-supported road wheels, exhibiting outer rubber surfaces, and which are supported upon a closed loop and outer tread.

Routine maintenance or repair involves replacement of either or both the outer and inner mating components associated with the road wheel. Essentially, road wheels are subject to such damages as their rubberized outer annular surfaces. Such replacement, particularly of the inner wheel component located behind the inwardly projecting tread teeth, further dictates the use of a lifter element, being typically situated between an inner tread surface of the tracked vehicle and an axle supported location of the road vehicle. The lifter element, combined with a controlled and limited translation of the tank tread, results in the lifter element vertically separating the specified wheel from the surface and inwardly engaging teeth of the tank tread, whereupon the wheel may be removed from the axle.

In use, it has been found that removal of road wheels, either through normal wear and tear usage or as a result of some event, can be complicated by force misalignments occurring between the inner wheel rim and the bolt portion of the axle. Such resistance to removal can also result from rust or other chemical erosion occurring between either or both of outer and inner wheel components and the underlying axle supported hub.

In one known application, removal of the road wheel is facilitated by the repeated application of a sledgehammer against the outer/inner road wheel components, resulting in the wheel becoming forcibly disjarred from its associated hub. A drawback of this technique is the undesirable damage caused to both the wheel as well as to the associated vehicle tread, particularly in instances in which the user attempts to remove only the outer wheel component and without the utilization of such as a lifter rod for vertically actuating the entire road wheel assembly.

Among other prior art references is U.S. Patent No. 6,237,206, issued to Bezemer et al. (*1*), which discloses a wheel pulling and transporting device incorporating a trolley, an actuating cylinder vertically supported upon the trolley and supporting a frame exhibiting a threaded hole, and a threaded shaft in rotatable engagement with the threaded hole. A retainer means is provided for retaining the device in contact with an associated wheel hub and such that, upon being attached, the shaft is rotated to urge the frame away from the wheel hub. As further disclosed, an additional rearward (or pulling) force is exerted by operating a member projecting device (see further alternative variant of figure 6 in Bezemer).

U.S. Patent No. 5,479,688, issued to Rubino et al. (*2*), discloses a pulling tool for pulling a rotor of a motor from a shaft (or a fan from a shaft). A plurality of hooked arms are secured at one end to circumferential spaced locations of the housing (such as wherein are defined through holes) and at opposite ends either extend through aperture locations of a wheel hub or, alternately, frictionally engaging backside locations of the wheel hub.

As further best illustrated in figure 4 in Rubino, the housing actuates relative to a central screw and in order to provide the combined pulling and rotating (torque) forces to the wheel hub. As further illustrated in the variant of figure 13 in Rubino, a smaller sized adapter can be employed for removing smaller-size components, such as bolts and the like.

U.S. Patent No. 5,410,792, issued to Freeman (*3*), discloses a caster wheel axle extraction apparatus incorporating a housing defining a compartment having an annular seat at an inner end thereof for receiving and seating an outer component of a work piece. An inner component thereof is tightly fitted through the outer component and aligned along a longitudinal axis of the housing. An aperture is defined through an annular seat and an elongated cylinder is supported adjacent to the housing with an elongated piston rod extending from the cylinder along the longitudinal axis. Upon selective actuation of the actuator, the piston rod is extendable along the longitudinal axis through the aperture in the seat and into contact with the inner component fitted through the outer component and seated in the compartment of the housing. Finally, the outer component is engaged about the inner compartment and is clamped against the seat on the inner end of the compartment to permit passage therethrough of the inner compartment in response to axial movement relative to the extraction from the outer component.

U.S. Patent No. 4,729,157, issued to McCue (*4*), discloses a wheel puller for use on large wheels and tire assemblies and which includes a plate adapted for attachment to a tire rim. A back plate is spaced from the first plate and extends across the axis of the wheel hub. Two wedge blocks

are placed between the back plate and wheel hub, on either side of the center line of the wheel hub. A driving wedge is further inserted between each wedge block and the back plate such that the driving wedges are alternately tapped with a hammer to pull the rim away from the hub.

U.S. Patent No. 4,287,653, issued to Bloch (*5*), discloses a force applying device for removing a blower wheel from a shaft and which includes a plurality of bracket members tightly held against an exterior of a motor housing by a tightened band. A threaded rod cooperates with each bracket member and such that each threaded rod can be rotated with respect to its bracket member to be physically moved against the blower wheel, which separates from its associated shaft.

U.S. Patent No. 4,042,139, issued to Pernsteiner et al. (*6*), discloses a vehicle wheel-removing and handling device and which is similar in many structural aspects to the device previously disclosed in Bezemer in that it includes a trolley supported device. Pernsteiner additionally teaches a hydraulic lifting ram cylinder operating a pair of gripping lever arms, which terminate in tire-gripping members. The inner end of at least one of the lever arms is operatively connected to a hydraulic clamping cylinder assembly and to facilitate removal and the assembly further teaches the rotating of the wheel to a horizontal position, following its removal from the vehicle, and to facilitate access to its brake drum for cleaning or repair.

U.S. Patent No. 3,638,294, issued to Durant (*7*), discloses a wheel puller in the form of a cylinder containing at least two telescoping portions. The cylinder includes a peripheral flange and a U-shaped collar slips over the cylinder and engages the flange. A second U-shaped collar slips over a shaft and engages a wheel to be pulled. Tie rods are connected to the two collars and a piston rod connected to one of the pistons, which in turn engages the shaft end.

Finally, U.S. Patent No. 1,750,840, issued to Grover (*8*), discloses a wheel puller having a sleeve member provided at one end with an internally tapered portion to cooperate with a compressible ring adapted to be screwed onto a wheel hub. The other end of the sleeve member is internally threaded to cooperate with an expansible ring which is adapted to screw into the sleeve and which is internally tapered. An externally tapered guide is fitted within the expansible ring and, upon applying force thereto, expands the rings whereby the threads of the latter more tightly engage the threaded portion of the sleeve. Cooperating with a plunger, a guide is further disclosed as a wedge member adapted to bear against the ends of the plunger, which cooperates with the end of the wheel axle. The plunger is constructed hollow and preferably internally threaded to screw over the end of the wheel axle.

4. Summary of the Invention

The present invention discloses a tracked vehicle road wheel puller for forcibly removing, by applying a combined pulling and twisting force, to either or both of outer and inner road wheels associated with a tracked vehicle. In particular, the present invention is an improvement over prior art devices in that it provides a portable and powered device for quickly and efficiently removing a road wheel from an underlying hub and without inflicting undue damage to the wheel, hub or track.

The road wheel further includes outer and inner wheel components bolted to a circular array of lugs extending from the vehicle hub. The wheel components each exhibit an outer rubber surface supported upon a tread inner surface and typically upon opposite sides of inwardly directed teeth extending from the tread surface.

The wheel puller assembly typically includes a planar shaped and ground supported base, to which is secured in upwardly extending fashion a cylinder leg. The leg is pivotally connected to the base in a preferred embodiment, however it is understood that the leg can also be fixedly secured to the base within the scope of the invention.

A powered cylinder is pivotally secured to an upper end location of the cylinder leg. The cylinder includes first and second telescoping components and terminates in a clamp for engaging respective locations along an annular rim associated with at least one of the outer and inner road wheel components. In any one of a number of preferred embodiments, the cylinder can operate utilizing any of electrical, hydraulic or pneumatic power sources. The clamp is adapted to engage a location associated with either or both the outer and inner road wheel components and in order to apply at least one of a pulling and twisting force to forcibly remove the road wheel from the hub.

5. Brief Description of the Drawings

Reference will now be made to the attached drawings, when read in combination with the following detailed description, wherein like reference numerals refer to like parts throughout the several views, and in which:

Figure 1 is an exploded view of the tracked road wheel puller according to a first preferred embodiment of the present invention;

Figure 2 is an assembled view of the tracked wheel puller illustrated in figure 1; figure 3 is

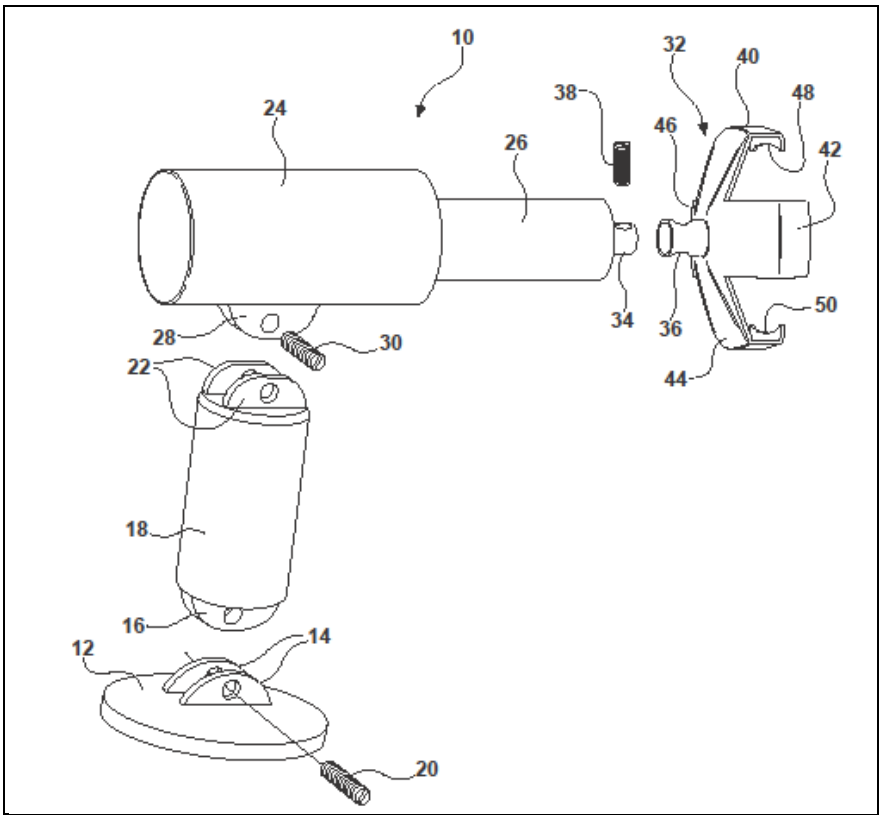

Figure 1. Exploded view of puller.

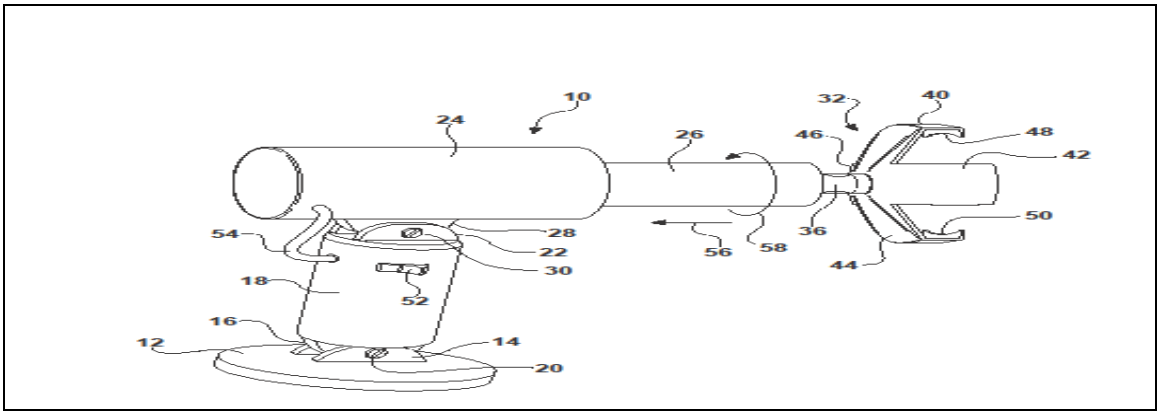

Figure 2. Assembled view of puller.

an exploded view of a tracked road wheel puller according to a second preferred embodiment and illustrating a variation in the configuration of the road wheel clamp portion; figure 4 is an environmental view of a selected tracked wheel illustration and by which a lifter element is applied between an inner tread surface of the vehicle track and an axle supported location of a given road wheel and in order to assist in the forcible removal of the outer and inner road

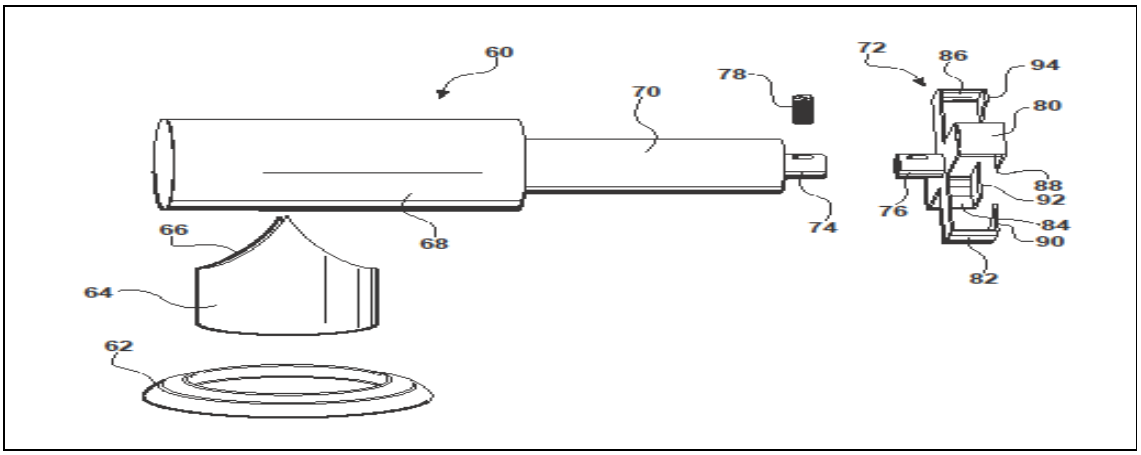

Figure 3. Exploded view of puller with clamp variation.

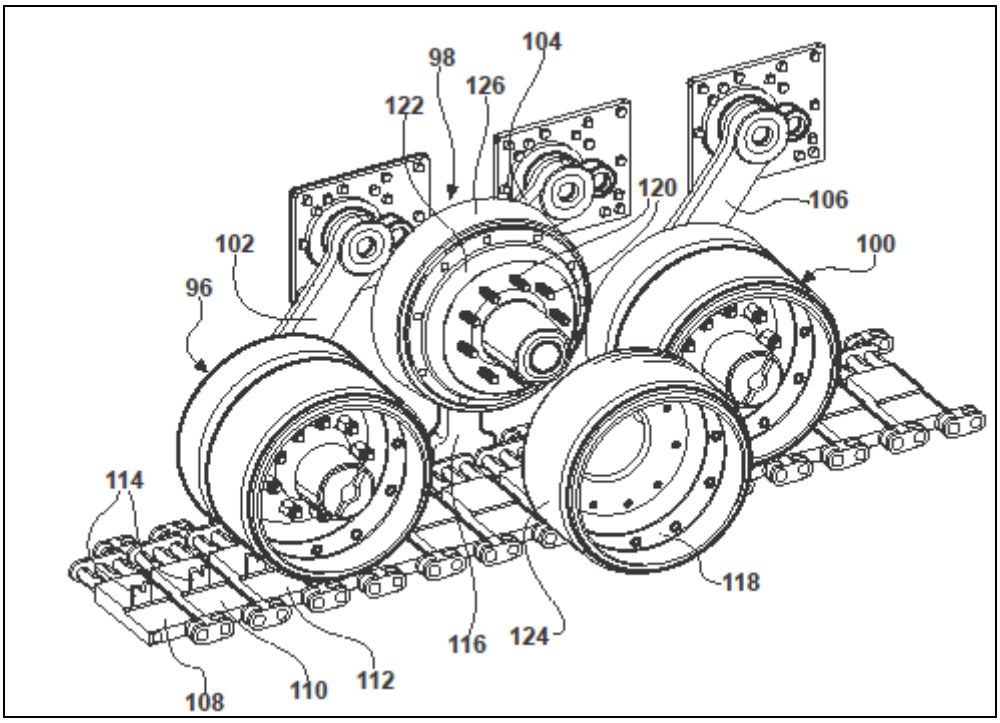

Figure 4. Environmental view of tracked wheel.

wheel components; and figure 5 is a cutaway view of a given application of the road wheel removal device, and by which the road wheel clamp is configured for engaging an inner annular rim surface associated with an inner road wheel component.

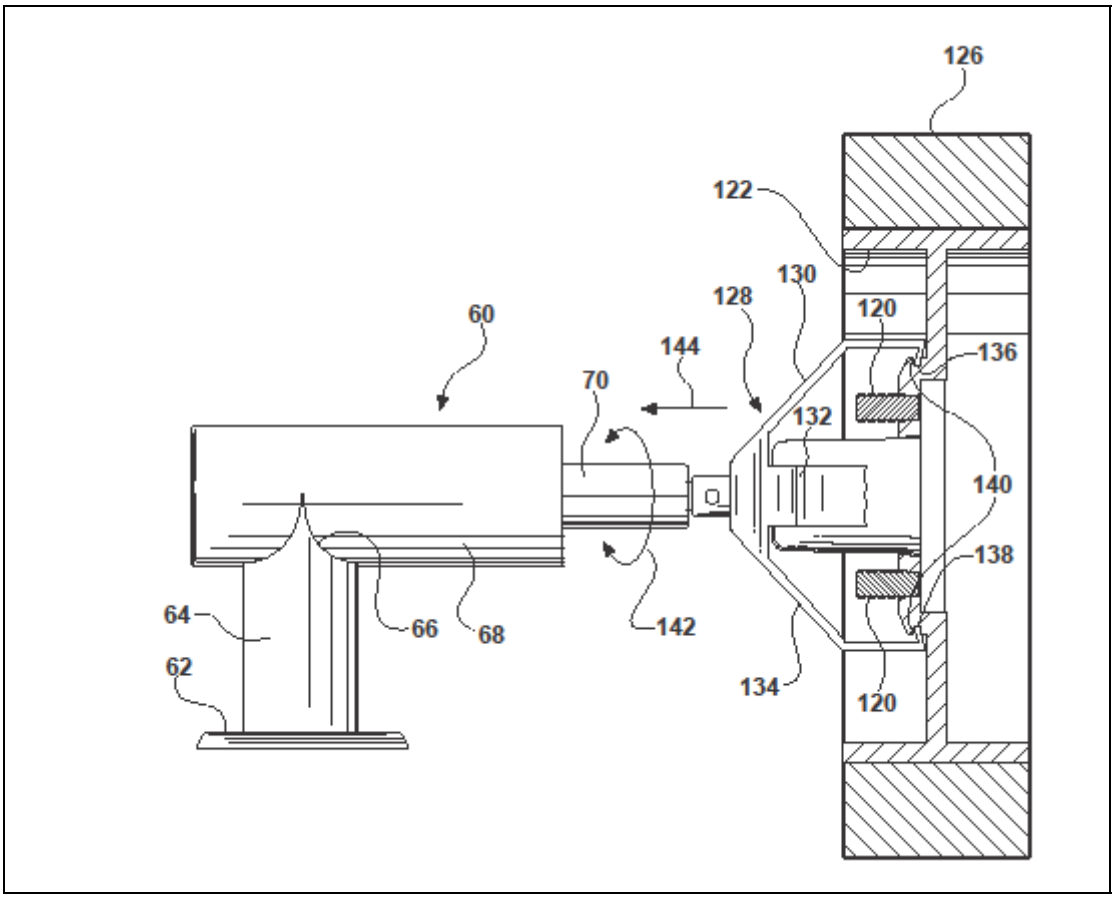

Figure 5. Cutaway view of application of removal device.

6. Description of the Preferred Embodiments

Referring now to figure 1, a powered road wheel puller device is illustrated at 10 according to a first preferred embodiment of the present invention. As previously described, the wheel puller device 10 discloses a ground-supported, powered, and articulated device exhibiting a clamp fixedly secured to a location of the road wheel and for forcibly removing the wheel from its axle by applying a combined pulling and twisting force.

As illustrated in figures 1 and 2, the components of the wheel puller assembly 10 include the provision of a base plate 12, having a substantially flattened and annular overall shape. A pair of spaced-apart guide members 14 project from an upper surface of the base plate 12 and locate a downwardly projecting and seating member 16 associated with a cylinder leg 18. A pin, shown at 20 in figures 1 and 2, seats through the aligning apertures established by the guide members 14 and sandwiched seating member 16.

A further pair of spaced-apart guide members 22 are located in extending fashion from an opposite and top surface of the cylinder leg 18. A powered cylinder is illustrated and includes a first (or outer) component 24, to which is telescopically secured a second (or inner) component 26. In a preferred embodiment, components 24 and 26 constitute in combination a conventional helical hydraulic rotary actuator. Exemplary of such actuators is the L10 Series (Helac Corporation, Enumclaw, WA). A seating portion 28 extends from a lower surface of the first cylinder component 24 and, as with the pivotal engagement established between the pedestal base and the cylinder leg, the portion 28 seats between the spaced apart guide members 22 so that a pin 30 inserts through aligning apertures associated with the guide members 22 and seating portion 28.

A clamp, see as generally referenced at 32, secures to an end of the second cylinder component 26 (see in particular end-extending shaft portion 34 associated with the second cylinder component 26) and receives extending portion 36 of the clamp 32. A pin 38 seats through aligning apertures established between the seating shaft 34 and extending portion 36 of the clamp 32 and in order to fixedly secure the clamp to the cylinder.

As shown, the clamp 32 includes a plurality of radially outwardly extending claws, see at 40, 42, 44, and 46, each terminating in an inwardly directed finger edge, see as illustrated by example at 48 and 50 for selected illustrated claws 40 and 44. The radially extending claws 40, 42, 44, and 46 further exhibit a forward angling consistent with the direction of a longitudinal axis passing through the cylinder and, as will be further explained, enable the inwardly directed finger edges (again 48 and 50) to engage suitable locations along such as an annular rim associated with either or both of outer and inner components of a road wheel.

It is also envisioned that the power cylinder can incorporate any one of electric, hydraulic, or pneumatic power sources which can be further incorporated, in one variant, into the cylinder leg 18. In the instance of a hydraulic or pneumatic actuated assembly, a battery and motor (not shown) are built into the cylinder leg 18 and, upon actuating a switch 52, a fluid source communicates with the first cylinder 24, such as through an input line 54 extending from the leg 18 to selectively actuate the second (inner) cylinder component 26 relative to the first (outer) component 24.

In the instance of an electrically powered motor, suitable components are incorporated into the leg 18 and first cylinder 24 which substitute for the hydraulic or pneumatic driven components. As further referenced in figure 2, the objective of the wheel puller assembly 10 is to actuate selected one or both of axial withdrawing forces, as referenced by arrow 56 and bi-directional twisting forces, see rotating arrow 58, and to assist in forcibly disengaging the road wheel from its associated axle.

Referencing figure 3, a wheel puller assembly is illustrated according to a second preferred embodiment 60 and includes a base plate 62, upon which is fixedly secured a modified cylinder leg 64. The cylinder leg 64 includes an arcuate and recessed top inner surface 66, upon which is seatingly engaged a first (or outer) cylinder component 68. A second (inner) cylinder component 70 is again both axially and/or rotatably engaged to the outer cylinder component 68, such as by a suitable electrical, hydraulic, or pneumatic power source which may be built into the cylinder leg 64. In a preferred embodiment, components 68 and 70 constitute in combination a conventional helical hydraulic rotary actuator. Exemplary of such actuators is the L10 Series (Helac Corporation, Enumclaw, WA).

As with the first preferred embodiment, a clamp is referenced generally at 72 and secures to an end of the second cylinder component 70, again by an end extending shaft portion 74 associated with the second cylinder component 70 and which receives in seating fashion an extending portion 76 of the clamp 72. A pin 78 seats through aligning apertures established between the seating shaft 74 and extending portion 76 of the clamp 72 and in order to fixedly secure the clamp 72 to the cylinder component 70.

As further shown, the clamp 72 includes a plurality of radially outwardly extending claws, see at 80, 82, 84, and 86, each again terminating in an inwardly directed finger edge, see as illustrated at 88, 90, 92, and 94 for respective claws 80–86. As with the first preferred embodiment, the radially extending claws enable the inwardly directed finger edges to engage suitable locations along such as an annular rim associated with either or both of outer and inner components of a road wheel.

Referring now to figure 4, an illustration is given of a routine maintenance situation involving the replacement of either or both of outer and inner mating components associated with a given road wheel. In particular, figure 4 illustrates a plurality of three road wheel assemblies 96, 98, and 100, supported by respective hub and arm assemblies 102, 104, and 106, respectively, in turn forming portions of an axle associated with the tracked vehicle.

A portion of an articulated track assembly is illustrated by pivotally engaged components, see at 108, 110, 112, et seq., formed in a closed loop. The road wheels (again as illustrated by example at 96, 98, and 100) each include both outer and inner wheel components, each typically exhibiting a rubberized outer surface, which are supported upon an inwardly facing surface of the track and further such that inwardly extending teeth (see at 114) associated with each of the track components 108, 110, 112, et seq., seat within a space established between each pair of outer and inner wheel components.

Replacement of the road wheels, particularly of the inner wheel component located behind the inwardly projecting tread teeth 114, further dictates the use of a lifter element, which is typically situated between a location along the inner tread surface and an axle supported location of the road vehicle. In the illustration of figure 4, a lifter element is referenced at 116, in use with selected road wheel subassembly 98. The lifter element 116, combined with a controlled and

limited translation of the tread (typically through coordination between the vehicle driver and an observer), results in the lifter element 116 rotating to a substantially vertically extending position, thereby separating the wheel subassembly 98 from the inner tread surface and the inwardly engaging teeth of the tank tread.

At this point, the outer wheel component 118 may be removed from the axle, typically first by removing a plurality of nuts (see as shown for example in use with wheel subassemblies 96 and 100) associated with a circular bolt array 120 illustrated in extending fashion from wheel hub associated with assembly 104. It is also understood that, in given situations, the powered wheel-puller assembly makes possible the removal of the outer wheel component, associated with any of the road wheel subassemblies, and without necessarily first employing the lifter element (see again as shown at 116) for vertically elevating the wheel from the tread inner surface. This is also due to the fact that the outer wheel (as shown at 118) is located outside of the inwardly projecting tread teeth 114, and which would otherwise provide an obstruction to the corresponding inner road wheel component (at 122) sandwiched between the tread teeth and the axle.

In use, it has been found that removal of road wheels, either through normal wear and tear usage or as a result of some event, can be complicated by force misalignments occurring such as between the inner wheel rim and the bolt portion of the axle. As previously described, such resistance to removal can also result from rust or other chemical erosion occurring between either or both of outer and inner wheel components and the underlying axle supported hub.

Referring finally to figure 5, a cutaway view is shown of a given application of the road wheel removal device for removing an inner wheel component (such as at 122 in figure 4 and presumably following the removal of the corresponding outer wheel component 118). As also previously described, each of the outer and inner wheels includes an outer annular extending and rubberized surface (as referenced by outer rubberized surface 124 for outer wheel 118 and associated rubberized surface 126 for inner wheel 122). A common reason for replacing road wheels is the occurrence of cracks, chunking, or separation of the rubberized annular layer from the outer annular surface of the wheel.

Figure 5 further illustrates a modification of the wheel puller illustrated at 60 in figure 3 by which a version of a pin-connected clamp 128 includes radially outwardly and forwardly angled claws, as shown at 130, 132, and 134. Further illustrated are inwardly directed fingers (at 136 and 138 for claws 130 and 134), configured to engage an inner annular rim surface (as referenced at 140) associated with the inner road wheel component 122.

In this manner, the wheel-puller assembly is activated to alternatively, successively, or in combination, impart turning/twisting forces (arrow 142) or axial withdrawal forces 144 to forcibly disengage the wheel component 122 from the bolts 120 and inner axle. It is also envisioned that the arrangement of the pedestal base can be such that the wheel-puller assembly

is supported in an immovable fashion to assist in maximizing force generation against wheel component.

Having described the invention, other and additional preferred embodiments will become apparent to those skilled in the art to which it pertains, and without deviating from the scope of the claims in the following section.

7. Claims

1. A wheel-puller assembly for forcibly removing a road wheel from a hub and axle associated with a tracked vehicle, said assembly comprising:
    - a base;
    - a leg secured to and extending upwardly from said base; and
    - a powered cylinder secured to an upper end location of said leg, said cylinder including an outer component and an inner telescoping component terminating in a clamp; said clamp adapting to engaging a location associated with the road wheel and in order to apply at least one of a pulling and twisting force to forcibly remove the road wheel from the hub.
2. The wheel puller as described in claim 1, further comprising a pivotal connection established between said base and said leg.
3. The wheel puller as described in claim 1, further comprising a pivotal connection established between said leg and said powered cylinder.
4. The wheel puller as described in claim 1, said clamp further comprising a plurality of radially outwardly extending claws terminating in inwardly directed fingers for engaging respective locations along an annular rim associated with the road wheel.
5. The wheel puller as described in claim 4, the road wheel further including outer and inner wheel components, further comprising said inwardly directed fingers of said clamp engaging a recessed annular rim established about the inner wheel.
6. The wheel puller as described in claim 4, further comprising said radially extending claws angling in an angled direction consistent with a longitudinal axis passing through said cylinder.
7. The wheel puller as described in claim 1, said cylinder exhibiting a specified shape and size and further comprising at least one of an electric, hydraulic, and pneumatic power source.

8. The wheel puller as described in claim 7, further comprising a motor located in at least one of said leg and said outer cylinder component.

9. The wheel puller as described in claim 1, further comprising a pin for releasably securing said clamp to said powered cylinder.

10. The wheel puller as described in claim 1, said base further comprising an annular shaped base plate providing a pedestal support.

11. A wheel-puller assembly for forcibly removing a road wheel from a hub and axle associated with a tracked vehicle, the road wheel further comprising outer and inner wheel components bolted to a circular array of lugs extending from the vehicle hub, said assembly comprising:

    - a substantially flattened and plate-shaped base;

    - a leg extending upwardly from said base; and

    - a powered cylinder secured to an upper end location of said leg, said cylinder including first and second telescoping components and terminating in a clamp exhibiting a plurality of radially outwardly extending claws, said claws terminating in inwardly directed fingers for engaging respective locations along an annular rim associated with at least one of the outer and inner road wheel components; said clamp adapting to engaging a location associated with the road wheel and in order to apply at least one of a pulling and twisting force to forcibly remove the road wheel from the hub.

12. The wheel puller as described in claim 11, further comprising a pivotal connection established between said base and said leg.

13. The wheel puller as described in claim 11, further comprising a pivotal connection established between said leg and said powered cylinder.

14. The wheel puller as described in claim 11, said cylinder exhibiting a specified shape and size and further comprising at least one of an electric, hydraulic and pneumatic power source.

15. The wheel puller as described in claim 14, further comprising a motor located in at least one of said leg and said outer cylinder component.

16. The wheel puller as described in claim 11, further comprising a pin for releasably securing said clamp to said powered cylinder.

17. A wheel puller assembly for forcibly removing a road wheel from a hub and axle associated with a tracked vehicle, the road wheel further comprising outer and inner wheel components bolted to a circular array of lugs extending from the vehicle hub, the wheel components each exhibiting an outer rubber surface supported upon a tread inner surface

and upon opposite sides of inwardly directed teeth extending from the tread surface, said assembly comprising:

- a base;
- an upwardly extending leg pivotally connected to said base; and
- a powered cylinder pivotally secured to an upper end location of said leg, said cylinder including first and second telescoping components and terminating in a clamp for engaging respective locations along an annular rim associated with at least one of the outer and inner road wheel components; said clamp adapting to engaging a location associated with the road wheel and in order to apply at least one of a pulling and twisting force to forcibly remove the road wheel from the hub.

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